

(19) World Intellectual Property Organization
International Bureau



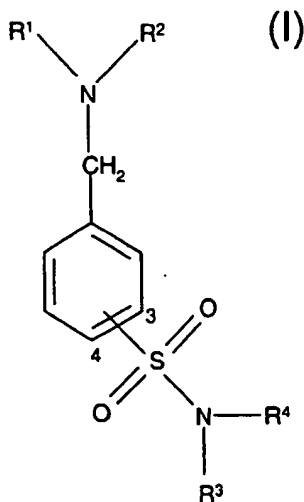
(43) International Publication Date
18 January 2001 (18.01.2001)

PCT

(10) International Publication Number
WO 01/04087 A1

- (51) International Patent Classification⁷: C07C 311/37, C07D 295/22, 295/12, 211/14, 213/38, 217/04, A61K 31/18, 31/445
- (74) Common Representative: ELI LILLY AND COMPANY LIMITED; Kingsclere Road, Basingstoke, Hampshire RG21 6XA (GB).
- (21) International Application Number: PCT/GB00/02361
- (22) International Filing Date: 15 June 2000 (15.06.2000)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
9916434.5 13 July 1999 (13.07.1999) GB
- (71) Applicant (for all designated States except US): ELI LILLY AND COMPANY LIMITED [GB/GB]; Kingsclere Road, Basingstoke, Hampshire RG21 6XA (GB).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): MILUTINOVIC, Sandra, Ginette [FR/GB]; 39 Devonshire Park, Reading, Berkshire RG2 7DX (GB). SIMMONDS, Robin, George [GB/GB]; 2 Plover Close, Wokingham, Berkshire RG41 3JD (GB). TUPPER, David, Edward [GB/GB]; 8 Mildenhall Close, Lower Earley, Reading, Berkshire RG6 3AT (GB).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:
- With international search report.
 - Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SULFONAMIDE SUBSTITUTED BENZYLAMINE DERIVATIVES AND THEIR USE AS MEDICAMENTS



(57) Abstract: A pharmaceutical compound of formula (I) in which the aminosulfonyl group is attached at the 3- or 4-position, and in which R¹ is hydrogen, C₁₋₆ alkyl, C₃₋₁₀ cycloalkyl, C₃₋₁₀ cycloalkyl-C₁₋₄ alkyl or optionally substituted phenyl-C₁₋₄ alkyl, R² is C₁₋₆ alkyl, C₃₋₁₀ cycloalkyl, C₃₋₁₀ cycloalkyl-C₁₋₄ alkyl, optionally substituted phenyl-C₁₋₄ alkyl or -(CH₂)₂NR⁵R⁶ where R⁵ and R⁶ are each hydrogen or C₁₋₆ alkyl, and R³ and R⁴ are each C₁₋₆ alkyl, C₃₋₁₀ cycloalkyl, C₃₋₁₀ cycloalkyl-C₁₋₄ alkyl, C₃₋₆ alkenyl, optionally substituted phenyl or optionally substituted phenyl-C₁₋₄ alkyl, or R¹ and R², or R³ and R⁴, or R⁵ and R⁶, together with the nitrogen atom to which they are attached, form a carbocyclic group containing 4 to 7 carbon atoms optionally substituted with one to three methyl or ethyl groups and optionally containing an oxygen atom or a further nitrogen atom, said carbocyclic group being optionally fused to an optionally substituted phenyl group; or a salt thereof.

WO 01/04087 A1

SULFONAMIDE SUBSTITUTED BENZYLAMINE DERIVATIVES AND THEIR USE AS MEDICAMENTS

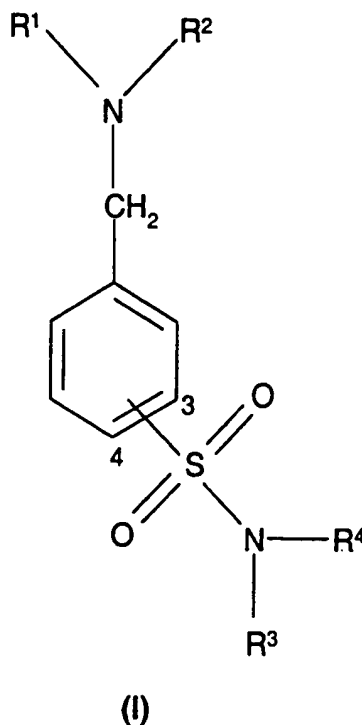
This invention relates to novel chemical compounds and their use as pharmaceuticals.

5

It is well known that chemical compounds which modulate the activity of neuronal calcium channels are potentially useful in treating disorders of the central nervous system.

10

The compounds of the invention have the following general formula:



15

- 2 -

in which the aminosulfonyl group is attached at the 3-
or 4-position, and in which

R^1 is hydrogen, C_{1-6} alkyl, C_{3-10} cycloalkyl, C_{3-10}
5 cycloalkyl- C_{1-4} alkyl or optionally substituted phenyl-
 C_{1-4} alkyl,

R^2 is C_{1-6} alkyl, C_{3-10} cycloalkyl, C_{3-10} cycloalkyl-
 C_{1-4} alkyl, optionally substituted phenyl- C_{1-4} alkyl or
10 $-(CH_2)_2NR^5R^6$ where R^5 and R^6 are each hydrogen or C_{1-6}
alkyl, and

R^3 and R^4 are each C_{1-6} alkyl, C_{3-10} cycloalkyl, C_{3-10}
cycloalkyl- C_{1-4} alkyl, C_{3-6} alkenyl, optionally
15 substituted phenyl or optionally substituted phenyl- C_{1-4}
alkyl,

or R^1 and R^2 , or R^3 and R^4 , or R^5 and R^6 , together with
the nitrogen atom to which they are attached, form a
20 carbocyclic group containing 4 to 7 carbon atoms
optionally substituted with one to three methyl or ethyl
groups and optionally containing an oxygen atom or a
further nitrogen atom, said carbocyclic group being

optionally fused to an optionally substituted phenyl group;

or a salt thereof.

5

The compounds of the invention have been found to be active in tests that show modulation of voltage-dependent calcium channels, and are thus indicated for use in the treatment of diseases in which such modulation is beneficial, in particular disorders of the central nervous system.

Thus, the invention includes a method of treating a disorder of the central nervous system, which comprises administering an effective amount of a compound of formula (I), or a pharmaceutically acceptable salt thereof.

The invention also includes the use of a compound of formula (I), or a pharmaceutically acceptable salt thereof, in the manufacture of a medicament for treating a disorder of the central nervous system.

The invention also includes the use of a compound of formula (I), or a pharmaceutically acceptable salt

thereof, in the manufacture of a medicament for treating a disorder of the central nervous system.

In the above formula (I), a C₁₋₆ alkyl group includes
5 methyl, ethyl, propyl, isopropyl, butyl, tert. butyl and hexyl, and is preferably methyl or ethyl. A substituted phenyl group is phenyl substituted with one or more, for example one to three, substituents selected from, for example C₁₋₄ alkyl, especially methyl, C₁₋₄ alkoxy,
10 especially methoxy and ethoxy, hydroxy, nitro, cyano, halo, especially chloro or fluoro, trihalomethyl, especially trifluoromethyl, carboxy and C₁₋₄ alkoxy-carbonyl. A halo atom is preferably chlorine, bromine or fluorine. A substituted phenyl group preferably has
15 one to three substituents selected from hydroxy, C₁₋₄ alkyl, halo, nitro and trifluoromethyl. An optionally substituted phenyl-C₁₋₄ alkyl group is preferably of the formula R-(CH₂)_n- where R is optionally substituted phenyl and n is 1 to 4, but the linking chain can also
20 be branched alkylene. A C₃₋₁₀ cycloalkyl group is preferably, for example, cyclopropyl, cyclobutyl, cyclopentyl or cyclohexyl and these groups may optionally be substituted by one or two C₁₋₄ alkyl, especially methyl, substituents. A C₃₋₁₀ cycloalkyl-
25 C₁₋₄ alkyl group is one such cycloalkyl group attached

to a C₁₋₄ alkyl, and is preferably of the formula

R-(CH₂)_n- where R is cycloalkyl and n is 1 to 4. When

R³ or R⁴ is C₁₋₆ alkyl it is preferably C₃₋₆ alkyl.

- 5 The groups R¹ and R², R³ and R⁴, and R⁵ and R⁶, can form a carbocyclic ring with the nitrogen to which they are attached and optionally also contain an oxygen atom or an additional nitrogen. Preferred examples, including the nitrogen of the amino sulfonyl group, are
- 10 pyrrolidino, piperazino, morpholino and especially 3,5-dimethylpiperidino.

A particular group of compounds of the invention is one of formula (I) in which R¹, R², R³ and R⁴ are each C₁₋₆

15 alkyl, C₃₋₁₀ cycloalkyl, C₃₋₁₀ cycloalkyl-C₁₋₄ alkyl or optionally substituted phenyl-C₁₋₄ alkyl, and R¹ can in addition be hydrogen, or R¹ and R², or R³ and R⁴ together with the nitrogen atom to which they are attached, form a carbocyclic group as defined above.

20

In a preferred group of compounds R¹, R², R³ and R⁴ are each C₁₋₆ alkyl, C₃₋₁₀ cycloalkyl, C₃₋₁₀ cycloalkyl-C₁₋₄ alkyl or optionally substituted phenyl-C₁₋₄ alkyl, and R¹ is in addition hydrogen.

It is preferred that R^1 is hydrogen. Furthermore, R^3 and R^4 , which can be the same or different, are preferably C_{1-4} alkyl. It is further preferred that R^2 is optionally substituted phenyl- C_{1-4} alkyl.

A further preferred group of compounds is one of formula (I) in which R^2 is $-(CH_2)_2NR^5R^6$.

A further preferred group of compounds is one of formula (I) in which R^3 or R^4 is C_{3-6} alkyl or when R^3 and R^4 are taken together with the nitrogen atom they form a piperidine ring which is substituted at the 3- and/or 5-positions with one or two methyl or ethyl substituents.

It will be appreciated that the compounds of the invention can contain one or more asymmetric carbon atom which gives rise to enantiomers. The compounds can be prepared as racemates or can be made from enantiomeric intermediates. Both racemates and enantiomers form part of the present invention.

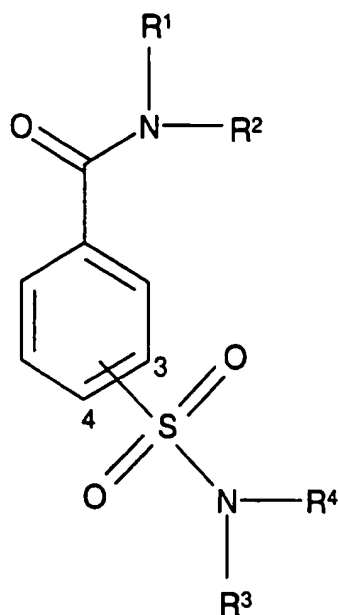
It will also be understood that salts of the compounds of the invention can be prepared and such salts are

included in the invention. They can be any of the well known acid addition salts. Acid addition salts are preferably the pharmaceutically acceptable non-toxic addition salts with suitable acids, such as those with
5 inorganic acids, for example hydrochloric, hydrobromic, nitric, sulfuric or phosphoric acids, or with organic acids, such as organic carboxylic acids, for example glycollic, maleic, fumaric, malic, oxalic, tartaric, citric, salicylic or o-acetoxybenzoic acids, or organic
10 sulfonic acids, methane sulfonic, 2-hydroxyethane sulfonic, toluene-p-sulfonic or naphthalene-2-sulfonic acids.

In addition to pharmaceutically-acceptable salts, other
15 salts are included in the invention. They may serve as intermediates in the purification of compounds or in the preparation of other, for example pharmaceutically-acceptable, salts, or are useful for identification, characterisation or purification.

20

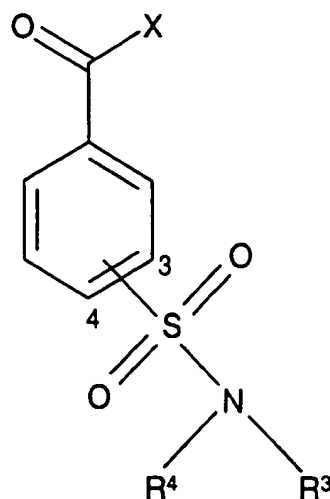
The invention includes a process for producing the compounds of formula (I) above which comprises reducing a compound of the formula:



(II)

The reaction is preferably carried out in an organic solvent, for example, at a temperature of 0° C. to 100° C., employing a reducing agent, for example lithium aluminium hydride.

Compounds of formula (II) can readily be prepared by conventional methods, for example, by reacting a compound of the formula:



(III)

where X is a leaving group such as, for example, halo or hydroxy, with an amine of the formula HNR^1R^2 .

5

The reaction is preferably carried out in an organic solvent such as, for example, chloroform or acetonitrile, at a temperature of from 0° C. to 100° C. such as, for example, ambient temperature.

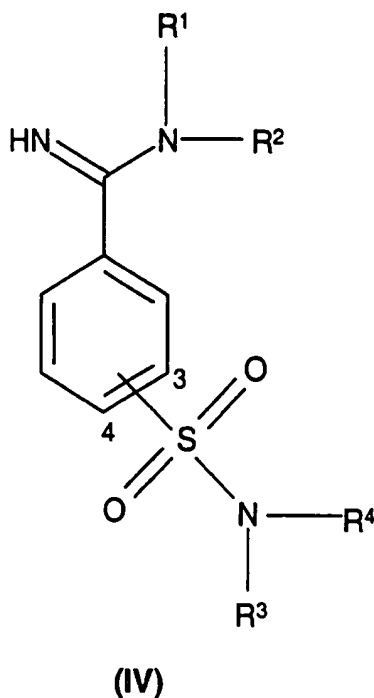
10

Intermediate compounds of formula (III) are known in the art and can be readily prepared by known methods. When an acid halide is employed (X is halo such as, for example, chloro), the reaction is preferably carried out in the presence of a solid phase scavenger to absorb the acid liberated by the reaction. When the free acid is employed (X is hydroxy), a condensing reagent such as,

15

for example, dimethylaminopropyl-ethylcarbodiimide can be employed.

A further route to the compounds of the invention, which is also included in the invention, involves the reduction of the imine corresponding to the compound of formula (III):



10

employing a reducing agent as, for example, sodium borohydride. Compounds of formula (IV) can readily be prepared by reacting an amine of formula R¹R²NH with the appropriate benzaldehyde derivative, which can, in its turn, be prepared by reducing the corresponding benzoic

15

acid derivative to the alcohol, followed by oxidation to the required benzaldehyde intermediate.

Amine reactants of the formula HNR^1R^2 are well known and
5 can be readily prepared by known methods. Those in which R^2 is $-(\text{CH}_2)_2\text{NR}^5\text{R}^6$ can, for example, be prepared by reductive amination, that is, by reacting the appropriate diamine with an aldehyde in reducing conditions.

10

Alternatively, compounds of formula (I) in which R^2 is $-(\text{CH}_2)_2\text{NR}^5\text{R}^6$ can be prepared by alkylation of the corresponding compound of formula (I) in which R^1 is hydrogen.

15

As mentioned above, the compounds of the invention are active in tests that indicate their utility in the treatment of diseases of the central nervous system.

20 The compounds modulate the activity of calcium channels and, in particular, they block voltage sensitive calcium channels as determined in a test based on Boot J. R., et al., Specificity of autoantibodies in the Lambert-Eaton Myasthenic Syndrome, Ann NY Acad. Sci. (1997), in
25 which measurements of calcium flux using calcium

sensitive dyes are made. Compounds described in the following Examples were found to inhibit voltage-dependent calcium channels in cloned human cell lines expressing specific voltage-dependent calcium channels
5 with an IC₅₀ of less than 10 µM.

The compounds of the invention are thus indicated for use in the treatment of anoxia, ischaemia, stroke and heart failure, migraine, diabetes, cognitive impairment,
10 pain, epilepsy, traumatic head or spinal injury, AIDS related dementia and blindness, amnesia, neurodegenerative diseases such as Alzheimer's, Parkinson's and Huntington's diseases and age-related memory disorders, Down's syndrome, mood disorders, drug
15 or alcohol addition withdrawal, nausea from chemotherapy, and carbon monoxide or cyanide poisoning.

The invention also includes a pharmaceutical composition comprising a pharmaceutically acceptable diluent or
20 carrier in association with the compound of the invention or a pharmaceutically acceptable salt or ester thereof.

The compound may be administered by various routes, for
25 example by the oral or rectal route, topically or parenterally, for example by injection or infusion,

being usually employed in the form of a pharmaceutical composition. Such compositions are prepared in a manner well known in the pharmaceutical art and comprise at least one active compound. In making the compositions

5 of the present invention, the active ingredient will usually be mixed with a carrier, or diluted by a carrier, and/or enclosed within a carrier which may, for example, be in the form of a capsule, sachet, paper or other container. When the carrier serves as a diluent,

10 it may be a solid, semi-solid, or liquid material which acts as a vehicle, excipient or medium for the active ingredient. Thus, the composition may be in the form of tablets, lozenges, sachets, cachets, elixirs, suspensions, ointments containing, for example, up to

15 10% by weight of the compound, soft and hard gelatin capsules, suppositories, injection solutions and suspensions and sterile packaged powders.

Some examples of suitable carriers are lactose,

20 dextrose, sucrose, sorbitol, mannitol, starches, gum acacia, calcium phosphate, alginates, tragacanth, gelatin, syrup, methyl cellulose, methyl- and propyl-hydrobenzoate, talc magnesium stearate and mineral oil. The compositions of the injection may, as is well known

25 in the art, be formulated so as to provide quick,

sustained or delayed release of the active ingredient after administration to the patient.

Where the compositions are formulated in unit dosage form, it is preferred that each unit dosage form contains from 5 mg to 500 mg. The term 'unit dosage form' refers to physically discrete units suitable as unit dosages for human subjects and animals, each unit containing a predetermined quantity of active material calculated to produce the desired therapeutic effect, in association with the required pharmaceutical carrier.

The active compound is effective over a wide dosage range and, for example, dosages per day will normally fall within the range of from 0.5 to 300 mg/kg, more usually in the range of from 5 to 100 mg/kg. However, it will be understood that the amount administered will be determined by the physician in the light of the relevant circumstances including the conditions to be treated, the choice of compound to be administered and the chosen route of administration, and therefore the above dosage ranges are not intended to limit the scope of the invention in any way.

The invention is illustrated by the following Preparations and Examples.

EXAMPLE 1

5 4-[(N,N-di-n-propylamino)sulfonyl]-benzoic acid

To a stirred solution of di-n-propylamine (3.03 g,
0.03 mole) in dry tetrahydrofuran (20 ml) at 0° C.
(ice/salt bath), was added 4-chlorosulfonylbenzoic acid
10 (2.2 g, 0.01 mole). Stirring was continued for 1 hour.
Ice water was added cautiously and the reaction made
acid with 2NHCl. The 4-[(N,N-di-n-
propylamino)sulfonyl]-benzoic acid was collected by
filtration as a white solid which was dried in vacuo at
15 40° C.

EXAMPLE 2

20 4-[(N-di-n-propylamino)sulfonyl]-N-4-methoxybenzyl-
benzamide

To a solution of 4-[(N,N-di-n-propylamino)sulfonyl]-
benzoic acid (2.85 g, 0.01 mole) in dry dichloromethane
25 (ml) at 0° C. was added oxalyl chloride (2.54 g,
0.02 mole) and dimethylformamide (4 drops). The

- 16 -

reaction mixture was stirred for 2 hours. The reaction was evaporated to dryness *in vacuo*. The resulting acid chloride was added to a stirred solution of *p*-methoxybenzylamine (1.51 g, 0.011 mole) and triethylamine (1.11 g, 0.011 mole) in dry tetrahydrofuran (25 ml) at 0-5° C. After stirring for 4 hours the reaction was poured into ice water and extracted with ethyl acetate. The solvent was washed with brine, dried and evaporated to dryness *in vacuo*. Chromatography on flash silica using 10% ethyl acetate/dichloromethane gave 4-[(N,N-di-n-propylamino)sulfonyl]-N-4-methoxybenzyl-benzamide as a white solid. M.p. 132-134° C.

15

EXAMPLE 3

N,N-di-*n*-propyl-4-[[(4-methoxybenzyl) amino]methyl] benzenesulfonamide

20

To a stirred solution of 4-[(N,N-di-*n*-propylamino)sulfonyl]-N-4-methoxybenzyl-benzamide (1.87g, 4.62mmole) in dry ether (50ml) was added a solution of 2M lithium aluminium hydride in tetrahydrofuran (4.63ml, 9.24mmole). The reaction was heated at reflux for 2 hours. After cooling to room temperature water (1ml)

25

was added dropwise with caution followed by 2NNaOH (1ml). When gas evolution ceased the reaction mixture was filtered through a pad of celite which was well washed with ether. After removal of the solvent in-
5 vacuo the product was purified by chromatography on flash silica eluting with 10% methanol/ethyl acetate. The resulting amine was converted to the maleic acid salt and re-crystallised from ethanol/ether to give *N,N*-di-*n*-propyl-4-{{(4-methoxybenzyl)amino)methyl} benzenesulfonamide maleate. mp. 133-135°C
10

Similarly prepared were:

N,N-di-*n*-propyl-3-{{(4-methoxybenzyl)amino)methyl} benzenesulfonamide maleate. mp. 160-162°C
15 *N,N*-di-*n*-propyl-4-{{(3,4-dimethoxyphenethyl)amino)methyl}benzenesulfonamide maleate. mp. 130-132°C
N-(3,3-dimethylpiperidino)-3-{{(4-fluorobenzyl)amino)methyl}benzenesulfonamide maleate. mp. 169-171°C
N-(3,3-dimethylpiperidino)-4-{{(4-fluorobenzyl)amino)methyl}benzenesulfonamide maleate. mp. 196-198°C
20 *N,N*-di-*n*-propyl-3-{{(4-fluorobenzyl)amino)methyl} benzenesulfonamide maleate. mp. 168-170°C
N-phenyl-*N*-*n*-propyl-4-{{dimethylamino)methyl} benzenesulfonamide maleate. mp. 154-156°C
25

N-(3,3-dimethylpiperidino)-3-{[(4-fluorobenzyl)-*N*-methylamino]methyl}benzenesulfonamide maleate. Mass spectrum: $MH^+ = 405$ (TSP+)

N-(3,3-dimethylpiperidino)-3-{[(4-fluorobenzyl)-*N*-benzylamino]methyl}benzenesulfonamide maleate. mp. 183-185°C

N-phenyl-*N*-methyl-3-{[(4-fluorobenzyl)amino]methyl}benzenesulfonamide maleate. mp. 194-196°C

N-phenyl-*N*-n-butyl-4-{[hexylamino]methyl}benzenesulfonamide maleate. mp. 106-108°C

N-(3-ethylpiperidino)-3-{[(4-fluorobenzyl)amino]methyl}benzenesulfonamide maleate. mp. 140-142°C

N-(3,3-dimethylpiperidino)-3-{[(cyclohexylmethyl)amino]methyl}benzenesulfonamide hydrochloride. mp. 147-149°C

N-(3-methylpiperidino)-4-{[(4-chlorophenethyl)amino]methyl}benzenesulfonamide maleate. mp. 176-178°C

N-(3-methylpiperidino)-4-{[(4-chlorophenethyl)-*N*-methylamino]methyl}benzenesulfonamide maleate. mp. 168-

170°C

3-{[[2-(dimethylamino)ethyl](4-fluorobenzyl)amino]methyl}-*N*-3,3-dimethylpiperidino-benzenesulfonamide maleate as an oil. Mass spectrum($MH^+ = 462$ (10%)) (TSP+)

3-{[[2-(dimethylamino)ethyl](cyclohexylmethyl)

amino]methyl}-N-3,3-dimethylpiperidino-
benzenesulfonamide maleate. mp. 149-151°C

5 EXAMPLE 4

4-{[2-(piperidino)ethyl](2-[3,4-
dimethoxy]phenylethyl)amino]methyl}-N,N-di-n-
propylbenzene sulfonamide dihydrochloride

10

To solution of N,N-di-n-propyl-4-{[(3,4-
dimethoxyphenethyl)amino]methyl}benzene sulfonamide (550
mg, 1mmole) in dry acetonitrile (100ml) was added sodium
carbonate (440mg, 4.4mmole), potassium iodide (166mg,
15 1mmole) and 2-chloroethylpiperidine hydrochloride
(184mg, 1mmole). The reaction was stirred and heated at
reflux for 18 hours. The reaction was poured into ice
water and extracted with ethyl acetate, washed with
brine, dried and evaporated to dryness *in-vacuo*.

20

Chromatography on flash silica by elution with
10%methanol/dichloromethane gave 4-{[2-
(piperidino)ethyl](2-[3,4-dimethoxy]phenylethyl)amino]
methyl}-N,N-di-n-propylbenzenesulfonamide which was
crystallised as its dihydrochloride salt. mp. 135-137°C

25

EXAMPLE 5

N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-(4-methylbenzyl)amine

5

A mixture of a 0.15 M solution of 3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzaldehyde in methanol (0.25 ml) and a 0.1 M solution of 4-methylbenzylamine in methanol (0.25 ml) was stirred at room temperature for 1
10 hour. A 0.15 M solution of sodium borohydride in methanol (0.25 ml) was added and stirring continued for a further 16 hours. The mixture was then applied to a methanol-washed 500 mg SCX solid phase extraction (SPE) cartridge and washed through with methanol (2.5 ml).
15 The cartridge was then eluted with a 2 M solution of ammonia in methanol (2.5 ml). The eluate was vacuum evaporated to give the required product. (TS-MS: m/z 387, $[M+H]^+$).

20 The following compounds were similarly prepared (mass spectrum values are given in brackets).

N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-[3-(4-methylpiperazin-1-yl)propyl]amine (423)

25

N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-(3-morpholin-4-ylpropyl)amine (410)

N-(4-chlorobenzyl)-*N*-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}amine (407/408)

N-(cyclohexylmethyl)-*N*-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}amine (379)

10 *N*-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-{3-(1*H*-imidazol-1-yl)propyl}amine (391)

N-butyl-*N*-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}amine (339)

15

N-(*tert*-butyl)-*N*-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}amine (339)

N-(2-chlorobenzyl)-*N*-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}amine (407/408)

20

N-(4-chlorophenethyl)-*N*-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}amine (421/422)

N-(2-chlorophenethyl)-*N*-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}amine (421/422)

N-(2,4-dichlorobenzyl)-*N*-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}amine (442)

N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-isopentylamine (353)

10 *N*-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-(3-methoxypropyl)amine (355)

N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-(2-methylbenzyl)amine (387)

15

N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-(3-methylcyclohexyl)amine (379)

N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-hexylamine (367)

20

N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-propylamine (325)

25 *N*-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-(4-methylphenethyl)amine (401)

N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-[3-(trifluoromethyl)benzyl]amine (441)

5 *N*-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-[3-(trifluoromethyl)phenethyl]amine (455)

EXAMPLE 6

10 1-({3-[(4-benzylpiperidin-1-yl)methyl]phenyl}sulfonyl)-3,3-dimethylpiperidine

A mixture of a 0.15 M solution of 3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzaldehyde in
15 dichloromethane (0.25 ml), a 0.1 M solution of 4-benzylpiperidine in dichloromethane (0.25 ml) and a 0.15 M solution of sodium tri-acetoxyborohydride in dichloromethane (0.25 ml) was stirred at room temperature for 22 hours. Methanol (1 ml) was added and
20 the mixture applied to a methanol-washed 500 mg SCX solid phase extraction (SPE) cartridge and washed through with methanol (2.5 ml). The cartridge was then eluted with a 2 M solution of ammonia in methanol (2.5 ml). The eluate was vacuum evaporated to give the
25 required product. (TS-MS: m/z 441, $[M+H]^+$).

The following compounds were similarly prepared (mass spectrum values are given in brackets).

2-(butyl{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}amino)ethan-1-ol (383)

2-(benzyl{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}amino)ethan-1-ol (417)

10 N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-N,N-bis(2-methoxyethyl)amine (399)

1-(3,4-dichlorophenyl)-4-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}piperazine (497)

15

N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-N-ethyl-N-(pyridin-4-ylmethyl)amine (402)

1-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-4-(4-fluorophenyl)piperazine (446)

20

4-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}piperazine-1-carbaldehyde (380)

25 4-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}morpholine (353)

1-[4-(4-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}piperazin-1-yl)phenyl]ethan-1-one
(470)

5

3,3-dimethyl-1-[[3-(pyrrolidin-1-ylmethyl)phenyl]sulfonyl]piperidine (337)

2-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-
10 1,2,3,4-tetrahydroisoquinoline (399)

N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N,N*-dipropylamine (367)

15 1-benzhydryl-4-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}piperazine (518)

N-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}-*N*-(2-methoxyethyl)-*N*-propylamine (383)

20

EXAMPLE 7

1-{3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzyl}piperidine-4-carboxamide

25

- 26 -

A mixture of a 0.15 M solution of 3-[(3,3-dimethylpiperidin-1-yl)sulfonyl]benzaldehyde in methanol (0.25 ml), a 0.1 M solution of piperidine-4-carboxamide in methanol/acetic acid 4:1 v/v (0.25 ml) and a 0.15 M
5 solution of sodium cyanoborohydride in methanol (0.25 ml) was stirred at room temperature for 18 hours. The mixture applied to a methanol-washed 500 mg SCX solid phase extraction (SPE) cartridge and washed through with methanol (2.5 ml). The cartridge was then eluted with a
10 2 M solution of ammonia in methanol (2.5 ml) and the eluate vacuum evaporated. The residue was dissolved in chloroform (2 ml) and the solution added to isocyanatomethyl-polystyrene (loading 1 mmole/g, 100 mg). The suspension was shaken at room temperature for
15 16 hours, then filtered. The resin was washed with chloroform (2 x 2 ml) and the combined filtrates vacuum evaporated to give the required product. (TS-MS: m/z 394, [M+H]⁺).

20

The following Examples illustrate typical formulations containing a compound of the invention.

25 EXAMPLE 8

Tablets each containing 10 mg of active ingredient are made up as follows:

	Active ingredient	10 mg
5	Starch	160 mg
	Microcrystalline cellulose	100 mg
	Polyvinylpyrrolidone (as 10% solution in water)	13 mg
	Sodium carboxymethyl starch	14 mg
	Magnesium stearate	3 mg
10		_____
	Total	300 mg

The active ingredient, starch and cellulose are mixed thoroughly. The solution of polyvinylpyrrolidone is mixed with the resultant powders and passed through a sieve. The granules so produced are dried and re-passed through a sieve. The sodium carboxymethyl starch and magnesium stearate are then added to the granules which, after mixing, are compressed on a tablet machine to yield tablets each weighing 300 mg.

EXAMPLE 9

Capsules each containing 20 mg of active ingredient are made as follows:

	Active ingredient	20 mg
	Dried starch	178 mg
	Magnesium stearate	2 mg
5		_____
	Total	200 mg

The active ingredient, starch and magnesium stearate are
10 passed through a sieve and filled into hard gelatine
capsules in 200 mg quantities.

EXAMPLE 10

15

Capsules each containing 20 mg of medicament are made as
follows:

	Active ingredient	20 mg
20	Lactose	171 mg
	Sodium lauryl sulphate	2 mg
	Sodium starch glycollate	6 mg
	Magnesium stearate	1 mg

25		200 mg

The active ingredient, lactose, sodium lauryl sulphate and sodium starch glycollate are mixed thoroughly. The blend is mixed with the magnesium stearate and filled
5 into hard gelatine capsules in 200 mg quantities.

EXAMPLE 11

Tablets each containing 20 mg and medicaments are made
10 as follows:

	Active ingredient	20 mg
	Lactose	103 mg
	Microcrystalline cellulose	150 mg
15	Hydroxypropylmethylcellulose	15 mg
	Sodium starch glycollate	9 mg
	Magnesium stearate	3 mg
		<hr/>
		300 mg
20		<hr/>

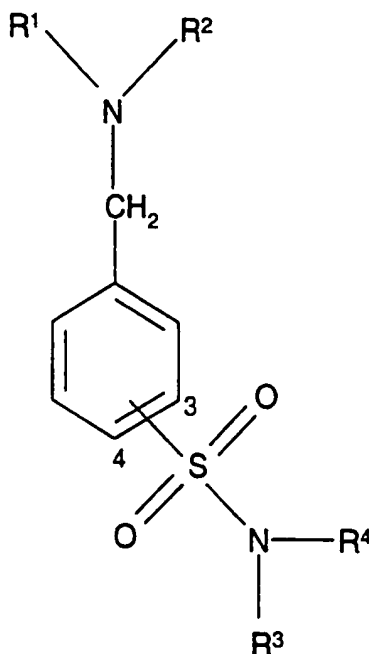
The active ingredient, lactose, microcrystalline cellulose, sodium starch glycollate and hydroxypropylmethylcellulose are passed through a sieve
25 and blended together. Water is added to the blended powders to form a damp mass. The damp mass is passed

- 30 -

through a coarse screen, dried, then re-screened. The dried granules are mixed with the magnesium stearate and compressed into tablets of 300 mg weight.

CLAIMS

1. A compound of the formula



(I)

5

in which the aminosulfonyl group is attached at the
3- or 4-position, and in which

10 R¹ is hydrogen, C₁₋₆ alkyl, C₃₋₁₀ cycloalkyl, C₃₋₁₀
cycloalkyl-C₁₋₄ alkyl or optionally substituted
phenyl-C₁₋₄ alkyl,

R² is C₁₋₆ alkyl, C₃₋₁₀ cycloalkyl, C₃₋₁₀

15 cycloalkyl-C₁₋₄ alkyl, optionally substituted

phenyl-C₁₋₄ alkyl or -(CH₂)₂NR⁵R⁶ where R⁵ and R⁶ are each hydrogen or C₁₋₆ alkyl, and

5 R³ and R⁴ are each C₁₋₆ alkyl, C₃₋₁₀ cycloalkyl, C₃₋₁₀ cycloalkyl-C₁₋₄ alkyl, C₃₋₆ alkenyl, optionally substituted phenyl or optionally substituted phenyl-C₁₋₄ alkyl,

10 or R¹ and R², or R³ and R⁴, or R⁵ and R⁶, together with the nitrogen atom to which they are attached, form a carbocyclic group containing 4 to 7 carbon atoms optionally substituted with one to three methyl or ethyl groups and optionally containing an oxygen atom or a further nitrogen atom, said
15 carbocyclic group being optionally fused to an optionally substituted phenyl group;

or a salt thereof.

20 2. A compound according to Claim 1 in which R¹, R², R³ and R⁴ are each C₁₋₆ alkyl, C₃₋₁₀ cycloalkyl, C₃₋₁₀ cycloalkyl-C₁₋₄ alkyl or optionally substituted phenyl-C₁₋₄ alkyl, and R¹ can in addition be hydrogen, or R¹ and R², or R³ and R⁴ together with

the nitrogen atom to which they are attached, form a carbocyclic group.

3. A compound according to Claim 2 in which R^1 , R^2 , R^3 and R^4 are each C_{1-6} alkyl, C_{3-10} cycloalkyl, C_{3-10} cycloalkyl- C_{1-4} alkyl or optionally substituted phenyl- C_{1-4} alkyl, and R^1 can in addition be hydrogen.
- 10 4. A compound according to Claim 3 in which R^1 is hydrogen, R^2 is optionally substituted phenyl- C_{1-4} alkyl and R^3 and R^4 are C_{1-6} alkyl.
- 15 5. A compound according to Claim 1 in which R^2 is $-(CH_2)_2NR^5R^6$.
6. A compound according to Claim 1 or 5 in which R^3 or R^4 is C_{3-6} alkyl or when R^3 and R^4 are taken together with the nitrogen atom they form a piperidine ring which is substituted at the 3- and/or 5-positions with one or two methyl or ethyl substituents.
- 20

7. A pharmaceutical formulation comprising a compound according to any of Claims 1 to 6 or a pharmaceutically acceptable salt thereof, together with a diluent or carrier therefor.
- 5
8. A compound according to any of Claims 1 to 6, for use as a pharmaceutical.
9. Use of a compound according to any of Claims 1 to 10 6, in the manufacture of a medicament for treating a disorder of the central nervous system.
10. A method of treating a disorder of the central nervous system which comprises administering an 15 effective amount of a compound according to Claim 1, or a pharmaceutically acceptable salt thereof.

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C07C311/37 C07D295/22 C07D295/12 C07D211/14 C07D213/38
C07D217/04 A61K31/18 A61K31/445

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C07C C07D A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

CHEM ABS Data, BEILSTEIN Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 726 386 C (I.G. FARBENINDUSTRIE AG) page 1, lines 26-36; example 13	1-3,7,8
X	US 3 954 830 A (E.E. RENFREW ET AL) 4 May 1976 (1976-05-04) column 6, lines 28-29; column 10, lines 3-5, in combination with table I, examples 8, 18, 20, 29	1-3
X	WO 93 13079 A (AGOURON PHARMACEUTICALS INC) 8 July 1993 (1993-07-08) page 53, compound 51; page 57, compound 57	1-3
X	S.H. REICH ET AL: J. MED. CHEM., vol. 35, no. 5, 1992, pages 847-858, XP000953095 scheme III, compounds 29h, 30h	1
	-/-	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

*** Special categories of cited documents :**

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

26 October 2000

Date of mailing of the international search report

07/11/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Van Amsterdam, L

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/GB 00/02361

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 93 04682 A (MCNEILAB INC) 18 March 1993 (1993-03-18) page 1, line 30 - page 2, line 14; table 4	1,2,6-10

BEST AVAILABLE COPY

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter. Appl. Application No

PCT/GB 00/02361

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 726386	C	NONE	
US 3954830	A	04-05-1976	US 3858259 A 07-01-1975
			US 4008262 A 15-02-1977
			CA 1085843 A 16-09-1980
			JP 844174 C 15-02-1977
			JP 49023224 A 01-03-1974
			JP 51016208 B 22-05-1976
WO 9313079	A	08-07-1993	AU 3276793 A 28-07-1993
WO 9304682	A	18-03-1993	AU 1363392 A 05-04-1993
			AU 657799 B 23-03-1995
			AU 2659992 A 05-04-1993
			CA 2095826 A 12-03-1993
			CA 2095847 A 12-03-1993
			EP 0562049 A 29-09-1993
			EP 0563345 A 06-10-1993
			FI 932103 A 10-05-1993
			FI 932104 A 10-05-1993
			HU 217068 B 29-11-1999
			HU 64535 A 28-01-1994
			HU 68963 A 28-08-1995
			JP 2941945 B 30-08-1999
			JP 6502870 T 31-03-1994
			JP 6502183 T 10-03-1994
			KR 196249 B 15-06-1999
			MX 9102407 A 31-05-1994
			NO 303780 B 31-08-1998
			NO 931695 A 27-05-1993
			NZ 240863 A 27-04-1995
			PT 99700 A 31-03-1993
			RU 2139867 C 20-10-1999
			WO 9304684 A 18-03-1993
			US 5569659 A 29-10-1996
			ZA 9109629 A 06-12-1993

BEST AVAILABLE COPY